HAND-BOOK OF PRECIOUS STONES

M. D. ROTHSCHILD

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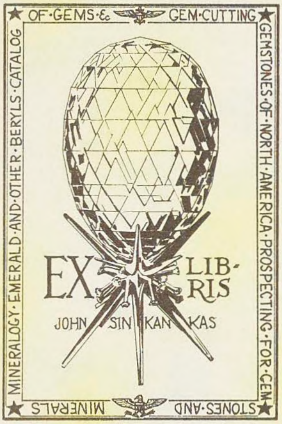

A HAND-BOOK OF

PRECIOUS STONES

BY

M. D. ROTHSCHILD

THIRD THOUSAND

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PREFACE.

The object of this little book is to convey to the merchant, the workman, and the amateur, in a condensed and accurate form, information concerning the various properties of precious stones. Besides drawing freely on a number of authorities, the author has used his practical experience to indicate such tests as an amateur can readily make. Specific gravity, hardness, and dichroism are tests which are easily mastered, and a thorough understanding of these three properties will assist in classifying doubtful gems.

Such stones have been dealt with principally as are used in commerce for jewelry and ornamental purposes.

The attention of the writer has often been called to the general lack of knowledge among the jewelers regarding precious stones other than diamonds, rubies, sapphires, and emeralds.

As there are so many other beautiful and rare gems which nature yields to man, and which are worthy of the jewelers' art, the author trusts that his book will awaken a new interest in the fascinating study of mineralogy as applied to precious stones, and that at some future day he may feel encouraged to enlarge upon this treatise.

M. D. ROTHSCHILD.

41 and 43 MAIDEN LANE,
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HAND-BOOK OF PRECIOUS STONES.

WHAT ARE PRECIOUS STONES?

The mineral to which the term "precious stone" is applied, must be adaptable for jewelry or ornamental purposes and must possess beauty, hardness, and rarity.

The beauty of a precious stone or gem consists of its color or colorlessness, brilliancy or softness of lustre, and transparency. To take a high and lasting polish, a mineral must be hard,—and many stones that would otherwise be highly valued are low in the estimate of worth because they do not possess of sufficient hardness to make them endure the wear and friction

to which a precious stone is subjected when used in the form of jewelry. The rareness of precious stones has a decided effect in determining their values. For instance, the crocidolite, commercially known as tiger-eye, was sold by the carat some years ago, and was largely used in the making of fine jewelry. To-day, this material is so plentiful that it is no longer classed among the higher gems, but serves for cameos and intaglios like chalcedony and onyx.

The changes of fashion have much to do with determining the market value of precious stones. Amethysts, topazes, cat's-eyes, aquamarines, alexandrites, and even emeralds and opals have been eagerly sought for at times and then again neglected for other gems, causing a sensible difference in the value of these stones.

There are all degrees of precious stones, from the valuable diamond and

corundums to the humbler quartz, amethyst, and topaz.

It has been a mooted question as to the proper dividing line between stones that deserve the title "precious," and those which should be placed in a so-called semi-precious or lower category. To draw such a line is hardly possible, as neither hardness, rareness, nor value would be a positive test—some of the hard stones, like zircon and almandines being less valuable than the softer opal, while the diamond, one of the most plentiful of precious stones, is at the same time, one of the most valuable.

Neither can price be taken as a complete test, because fashion makes a turquois, an opal, or an emerald much more valuable at one time than at another. All precious minerals used for ornamental purposes, from the diamond to quartz, or chalcedony, may properly be termed precious stones.

Physical Characters.

CRYSTALLIZATION.

Precious stones are found either in crystallized or amorphous conditions. The forms of crystallization are:

1 Isometric or Cubic; having the axes equal.
2 Tetragonal or Pyramidal } having only the
3 Hexagonal or Rhombohedral } lateral axes equal.
4 Orthorhombic or Trimetric . . }
5 Monoclinic or Oblique . . . } having the axes unequal.
6 Triclinic or Anorthic . . . . }

Most precious stones crystallize, but the specimens that have the crystallization clearly defined are seldom found. The amorphous condition includes the turquois, opal, and obsidian, which minerals are found in masses or veins surrounded by a matrix.

CLEAVAGE.

Many minerals can be separated readily in one direction by simply making a small indentation with a harder mineral, then introducing the blade of a knife into the scratch and striking it a sharp blow,—this separates the crystal. There are certain

planes at right angles where the crystal can be separated; this property is called cleavage and the planes, cleavage planes.

In some minerals cleavage is difficult to produce, while in others such as mica and rock-salt, cleavage is highly perfect and the number of separations produced is only limited by the thickness of the blade used in separating the planes.

The property of cleavage is very useful and of great assistance to the lapidary, as it enables him to shape a diamond or other hard stone nearly to the size he desires, and at the same time to save the extra material cleaved off, which can be used for smaller gems, and which under other conditions would have to be ground away.

FRACTURE.

Fracture surfaces are the result of the breaking of a crystal otherwise than by cleaving, and in a different direction from the cleavage planes.

When the form of fracture is composed of concave and convex surfaces it is called conchoidal; when free from inequalities it is known as even or smooth, and when covered by small splinters, splintery or uneven.

Optical Properties.

REFRACTION.

When a ray of light passes from one medium to another, or from the air to a crystal it is bent or refracted; this is called single refraction and takes place in the diamond, spinel, and garnet.

Most of the other transparent precious stones possess double refraction—that is, the ray of light enters the crystal and divides into two parts, one following the ordinary laws of refraction, while the other part or extraordinary ray does not obey the usual law.

There are precise methods for measuring the indices of refraction, but they are not applicable to polished gem stones.

POLARIZATION OF LIGHT.

Polarization is a peculiar modification which, under certain conditions, a ray of light undergoes. This property is easier to observe than double refraction.

If from a transparent prism of tourmaline two thin plates are cut, parallel to its axis, they will transmit light when they are placed above each other with the chief axis of each in the same direction.

When one of the plates is turned at right angles to the other, no light, or but very little, is transmitted, so that the plates appear black.

In passing through the first slip, the rays of light have acquired a peculiar property, which renders them incapable of being transmitted through the second, except when the two are held in a parallel position, and the rays are then said to be polarized.

In some doubly refracting crystals the two oppositely polarized beams are of

different colors, so upon double refraction and polarization depends the property of many gems which is called pleiochroism.

PLEIOCHROISM.

The dichroiscope is a handy little optical instrument, that will readily serve to distinguish the diamond, spinel, or garnet (all singly refracting minerals) from the ruby, beryl, or any of the doubly refracting stones. This instrument consists

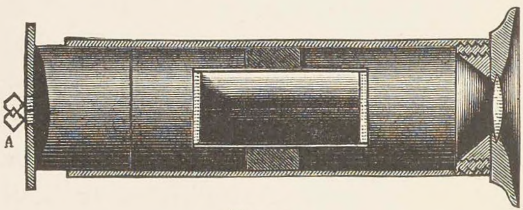

FIG. 1.

of a cleavage rhombohedron of Iceland spar, fastened in a brass tube about 2½ inches long, and ¾ of an inch in diameter. A sliding cap at one end has a perforation ⅛ of an inch square, and at the other end is a lens which will show a distinct

image of the square opening when the cap is pulled out about $\frac{1}{4}$ of an inch.

The pleiochroism of many stones can be determined at a glance with the dichroiscope.

When a stone is examined by means of the dichroiscope, it will show two images of the same hue, or of different hues, these square images (fig. 1, A) forming a right angle and being more distinct when viewed from one part of the stone than from another.

When the images are identical in color, the specimen may be a diamond, garnet, spinel, or glass. Should a red or ruby spinel approach the ruby in color, a quick and satisfactory test can be made with the dichroiscope, as the spinel will show two images of one color, while the ruby will show one image of aurora red and one of carmine red.

The dichroiscope is inexpensive, costing but a few dollars, and is very useful for rapidly deciding the species of many

stones. The following is a partial list of doubly refracting stones and their twin colors.

NAME OF STONE.	TWIN COLORS.	
Sapphire (blue)	Greenish straw	Blue
Ruby (red)	Aurora red	Carmine red
Tourmaline (red)	Salmon	Rose pink
" (brownish red)	Umber brown	Columbine pink
" (brown)	Orange brown	Greenish yellow
" (green)	Pistachio green	Bluish green
" (blue)	Greenish gray	Indigo blue
Emerald (green)	Yellowish green	Bluish green
Topaz (sherry)	Straw yellow	Rose pink
Peridot (pistachio)	Brown yellow	Sea green
Aquamarine (sea green)	Straw white	Gray blue
Beryl (pale blue)	Sea green	Azure blue
Chrysoberyl (yellow)	Golden brown	Greenish yellow
Iolite (lavender)	Pale buff	Indigo blue
Amethyst (purple)	Reddish purple	Bluish purple

COLORS.

The following is a partial list of the colors of precious stones:

Shades of White.—Quartz, opal, chalcedony.

Shades of Gray.—Labrador, smoky topaz, chalcedony, zircon.

Black.—Obsidian, tourmaline, jet.

Shades of Blue.—Lapis-lazuli, amethyst, chalcedony, spinel, zircon, sapphire, cyanite, tourmaline, turquois, odontolite, fluor spar.

Shades of Green.—Amazon stone, turquois, prase, beryl, bloodstcne, epidote, emerald, malachite, chrysoprase, chrysolite, idocras, olivine, garnet, chrysoberyl.

Shades of Yellow.—Opal, amber, topaz, beryl, jasper.

Shades of Red.—Garnet, carnelian, chalcedony, rose quartz, corundum, tourmaline, spinel, ruby.

Shades of Brown.—Zircon, garnet, smoky topaz, axinite, jasper.

Colorless.—Diamond, sapphire, spinel, zircon, topaz, rock crystal, moonstone.

LUSTRE.

Well polished precious stones display a decided lustre, which assists in determining their species.

The following is a list of some precious stones and their lustre :

Adamantine.—Diamond, zircon.
Resinous.—Garnet.
Vitreous.—Emerald, ruby, spinel.
Waxy.—Turquois.
Pearly.—Moonstone, opal.
Silky.—Crocidolite, quartz cat's-eye.
Metallic.—Hematite.
Greasy.—Olivine.

Some stones vary in lustre, from vitreous to pearly, etc.

STREAK.

The streak of a mineral is the color of its powder.

This powder varies in color, and may be white, gray, red, etc. It is obtained by scratching the mineral with a sharp file, or by rubbing the mineral on the back of an unglazed porcelain plate, when the color of the powder will appear on the plate.

It is remarkable that the streak of the diamond is gray to grayish-black, while that of the ruby is colorless or white.

HARDNESS.

One of the most important and distinguishing qualities of a gem stone is the property of enduring, resisting wear,—in short, hardness. To test the hardness of precious stones that have not been cut or polished, the following scale of ten minerals has been devised by Moh, a German mineralogist:

No. 1. Talc. Very soft; is easily broken or scratched with the finger-nail.

No. 2. Rock-salt. Soft; scratched with difficulty with finger-nail; readily cut with a knife.

No. 3. Calcite. Low degree of hardness; not to be scratched with finger-nail; easily scratched with a knife.

No. 4. Fluor spar. Fairly hard; is slightly scratched by a knife, but easily attacked with a file.

No. 5. Apatite. Medium hardness; does not scratch glass, or only faintly; does not give out sparks against steel; easily attacked with a file.

No. 6. Felspar. Easily scratches glass; is attacked by a file, and gives some sparks against steel.

No. 7. Quartz. Quite hard; is only slightly attacked by file; gives sparks readily against steel.

No. 8. Topaz. Very hard; is not attacked by a file.

No. 9. Sapphire. Hardest of all minerals but the diamond; attacks all other minerals.

No. 10. Diamond. Attacks all minerals; is not attacked by any.

To find the hardness of a stone, begin to test with the softest mineral, so that when the number is reached which will scratch the stone, there has been no injury to the specimen under examination. Half numbers are determined by the ease or difficulty with which a stone is scratched. For example, a stone which will resist No. 7 (quartz) and which is only faintly attacked by No. 8 (topaz) may be safely put down as 7.5, while a stone which resisted

No. 7 and yielded easily to No. 8 is to be classed as 7 in hardness.

These tests are readily applied to crystals or unpolished gems. With the polished stone greater care must be observed, and while a file test is often satisfactory, there is always the danger of striking the cleavage and breaking off a small piece of the stone.

SPECIFIC GRAVITY.

One of the most important tests which can be applied to a polished stone is that of specific gravity. Many stones, like the ruby and the spinel, the blue tourmaline and the sapphire, etc., look alike, but there is a sensible difference in their respective weights that a specific-gravity test will readily establish.

The weight of an object which is free to seek the centre of gravitation is called absolute weight, while the weight of an object compared with that of another con-

taining the same volume of matter is called the specific weight.

If a stone weighing 16 carats is placed in a vessel filled to the brim with distilled water and the stone displaces 6 carats of water, the specific gravity of the stone would be 16 ÷ 6, or 2.66, the specific gravity of quartz.

In other words, the stone would weigh 16 carats in the air and only 10 carats in the distilled water, showing a loss of 6 carats, which is the weight of the volume of water equal in bulk to the stone;—or absolute weight, 16 carats; specific weight, 10 carats; loss, 6 carats; 16 ÷ 6 = 2.66, specific gravity.

There are several methods of ascertaining the specific gravity of a stone.

First, by placing it in liquids of known specific gravity.

Second, by weighing the stone in air and then in distilled water or alcohol, and thus learning the weight of an equal bulk of water.

Third, by measuring or weighing the water which the stone displaces when immersed in a small vessel of known capacity.

Fourth, by means of the Nicholson hydrometer, a simple instrument consisting of a hollow glass cylinder, two dishes, and a glass vessel.

As the jewelers' balances are well adapted for the ordinary work of taking specific gravity, or can be easily adapted for such work, the second method will usually be the more practical to follow.

The author has had very satisfactory service from a $30 balance, and any well adjusted balance will give fair results.

The following accessories are necessary to take the specific gravity of a stone:

Distilled water about 60° Fahr.

A very fine thread of platinum wire with which to suspend the stone (fig 4).

A glass-beaker for the water (fig. 3, C).

A bench to hold the beaker over the pan (fig. 2).

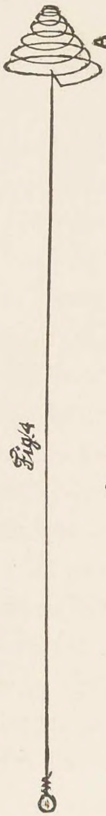

Fig. 4

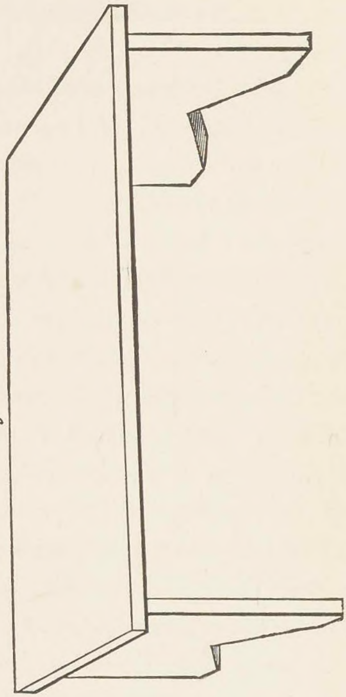

Fig. 2

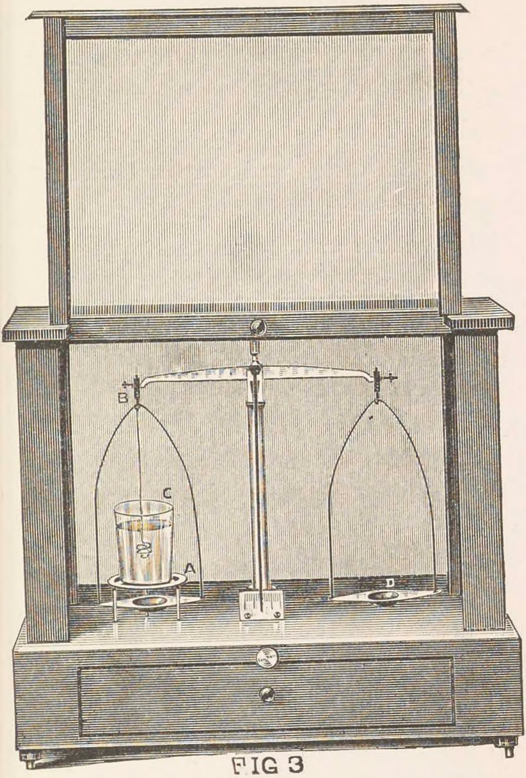

FIG 3

The distilled water is easily obtainable from any druggist. The platinum wire should be bent to hook into the top of the balance frame, (fig. 3, B) and for ordinary small stones it will be convenient to twist the other end into a cork-screw shape or receptacle (fig. 4, A).

The beaker can be a small, thin glass cup of any kind, and the bench is easily produced from wood (fig. 2) or of metal with three supports (fig. 3, A).

To ascertain the specific gravity, attach the platinum wire to the balance frame,(fig. 3, B) and allow the lower end to rest in the water; then balance this carefully by adding weights to the other side (fig. 3, D) until the balance is exact.

The stone to be weighed in water is a ruby, and weighs two carats in the air.

Clean the stone carefully with water to free it from air bubbles; then place it in the screw of the wire (fig. 4, A) and weigh carefully. If the stone weighs 1½ carats it will have displaced ½ ct. of water: or,

weight in air, 2 carats; weight in water, $1\frac{1}{2}$ carats; loss, $\frac{1}{2}$ carat; $2 \div \frac{1}{2} = 4$, which will be the specific gravity of the ruby.

The Jolly spiral balance can also be used for taking specific gravity, but it is not so practical or accurate for small stones as for the larger ones.

Weight.

The valuable precious stones are bought and sold by the carat. This weight is equal to about 3.17 grains or about .205 milligrams.

The carat is divided into fractions of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, and also arbitrarily into four grains; that is, each quarter of a carat is counted one grain, thus forming the basis for the calculation of pearls.

In commerce, a carat diamond is sometimes called a four-grain stone, and a carat-and-a-half stone is six grains, etc., etc.

The weight of the carat being arbitrary, it varies in different countries, some being heavier and others lighter than .205 milligrams.

The writer wrote to three prominent balance-makers in the United States some months ago for their carat standards and was surprised to find that they all differed. This will account for discrepancies in weight resulting between the balances of different makers. Of late there has been a decided movement in Europe, headed by the French Chambre Syndicale of jewelers, in favor of the unification of the carat, so that the weight of a French or Dutch carat will equal that of an English, American, or any other carat. This reform will probably be accompanied by the adoption of the decimal system of dividing the carat, and the discarding of the complicated fractional system.

After having tried the decimal weights for many months, the author can testify to a decided gain in time and accuracy from their use.

FUSIBILITY.

The blow-pipe or dry test for minerals

is convenient to apply to small bits or splinters of a stone.

The mineral is either held by a pair of platina-pointed forceps, or powdered and placed on a metal plate or in a glass tube.

Before the blow-pipe, some minerals change color, but do not melt, while others retain their color, or swell up, or break into small particles, or melt into colorless or colored glasses.

The following is the scale of minerals used to test the different degrees of fusibility:

1. Gray Antimony. Fusible in coarse splinters in summit of candle flame without the blow-pipe.
2. Natrolite. Fusible in fine splinters in the summit of a candle flame without the blow-pipe.
3. Almandite. Does not fuse in candle flame; fuses easily before the blow-pipe in obtuse pieces.
4. Green Actinolite. Fusible before the blow-pipe in coarse splinters.

5. Orthoclase. Fusible before the blow-pipe in fine splinters.
6. Bronzite. Before the blow-pipe becomes rounded only on the sharp edges.

Magnetism.

There are but few precious stones that possess the power to act on the magnetic needle; among them are the chrysolite, cinnamon stone, almandine, pyrope, and garnet.

Transparency.

Precious stones are, on the basis of their relative transparency, divided into four classes, as follows: *Transparent*, or admitting light freely and clearly; defining objects when used as a lens. *Semi-transparent*, admitting light, but only partially defining objects. *Translucent*, admitting light faintly. *Opaque*, not admitting light.

The more valuable precious stones, excepting opals and turquoises, are generally transparent.

Phosphorescence.

Some precious stones display a distinct phosphorescence after exposure to the sunlight, and also upon the application of artificial heat, and through mechanical and electrical means.

Many diamonds, when taken to a dark room, appear quite luminous; this is also true of topaz, fluor spar, and other minerals.

Electricity.

Minerals acquire electricity through friction or heating, and in this state readily attract or repel small bits of paper and other light substances.

All minerals are electric, some displaying positive and others negative electricity.

The electric test of a precious stone refers to the length of time that a stone will retain electricity after friction or heating. Some stones lose this quality in a few minutes, while others retain it a long time.

The tourmaline is noted for its electrical properties, while the Brazilian topaz rendered electric by heating or rubbing has been known to affect the electric needle after 32 hours.

Cutting and Polishing.

Although a finely developed diamond, ruby, or other crystal is sometimes found and used for jewelry, the beauty of a precious stone generally remains hidden within a rough and unsightly exterior until the lapidary's art reveals the gem.

According to well known rules, there is one kind of cutting or faceting for the diamond or colorless gems and another for colored gems.

The brilliant cut, figs. 5 and 6, consists of an arrangement of fifty-six facets, exclusive of the table and culet. This cut is sometimes improved by the addition of eight star facets around the culet, which brings the number of facets up to sixty-four.

The following are the proportions of a well cut diamond or colorless gem :

$\frac{1}{3}$ above the girdle, fig. 6, A.

$\frac{2}{3}$ below " " " 6, B.

The table $\frac{2}{5}$ of the breadth of the stone, fig. 6, C.

The culet $\frac{1}{6}$ of the size of the table, fig. 6, D.

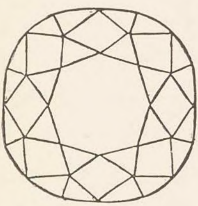

FIG. 5

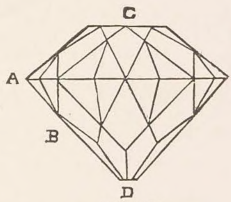

FIG. 6

These proportions do not refer to colored gems, which are cut thick or shallow to deepen or diminish the color of the stone. The step cut, fig. 7, now principally used for emeralds, can be advantageously used for other colored stones.

The crowned rose cut, fig. 8, is applied to small diamonds, and occasionally to col-

ored gems. This cut consists of twenty-four facets, and a well proportioned rose is one half of its diameter in thickness.

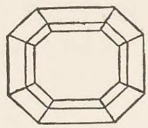

FIG. 7

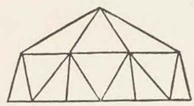

FIG. 8

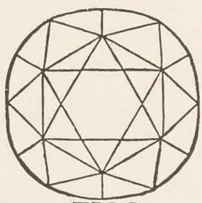

FIG. 9

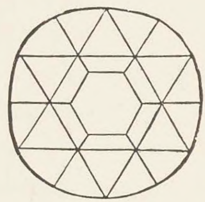

FIG. 10

To the smaller and more common roses only twelve facets are given.

Besides the above-mentioned forms, there are the:

Huitpan, or single cut.
16 facet " double "
24 " " single brilliant.
Cabochon " carbuncle.
Star cut, fig. 9.
Degree or rose cut, fig. 10.

The last two beautiful forms ot cutting are frequently given to fine paste or imitation diamonds.

Of late years nearly all gems have been cut quite round, and in many instances with a sacrifice of size and brilliancy.

DIAMOND.

The diamond is one of the most precious minerals, and yet it consists of pure carbon, the most common substance that is known, a substance that is present in all animal and vegetable bodies and in the larger number of minerals. When carbon is crystallized the result is the diamond, which is always found in detached crystals, either octahedrons or rhombic dodecahedrons, the planes of the angles being often convex or rounded,—this curving crystal being peculiar to the diamond.

The cleavage is perfect, and, parallel to the faces of the octahedron, the fracture is conchoidal or curved. The diamond is not acted upon by acids or alkalies, is in-

fusible but combustible, and burns under heat of a very high temperature. Diamond powder burns readily, but larger pieces are not affected by the blow-pipe.

The diamond is a non-conductor of electricity, but acquires positive electricity when rubbed, and retains it for half an hour. After being exposed to the solar rays, the diamond presents a distinct phosphorescence in the dark. It possesses single refraction, but belongs to those bodies which reflect light most strongly, and its magnifying power is much greater than that of glass; it does not polarize light; its lustre is adamantine, and specific gravity 3.5 to 3.6. The diamond is the hardest of all known minerals, ranking No. 10 in Moh's scale of hardness.

White, and the different shades from very light yellow to dark yellow or canary, comprise, according to the popular idea, the colors of the diamond. Yet the diamond is found in green, red, blue, brown, olive, orange, and black, and also

in the various shadings of these colors and in opalescent tints.

As the limpid or white diamond surpasses all other white stones in the power of its lustre and the magnificence of its fire, so do the colored diamonds outrank the emerald, ruby, sapphire, and other gems of like colors.

Colored diamonds, excepting light yellow and brown, are rare, and hence are the most valuable of precious stones. The limpid or perfectly white and the white with a bluish tint are the most sought after, while fine deep golden yellow or canaries and pronounced fancy colors always find a ready market.

Diamonds come principally from the mines in South Africa; some are found in Brazil and India, and fewer in Sumatra, Borneo, the Ural Mountains, and Australia. Crystals have also been found in the United States.

The amorphous or carbon diamond is found only in Brazil. The pebbles or

masses are opaque, steel-gray to black in color, and sometimes weigh 1,000 carats.

This carbonate is principally used to point rock-drills and for other engineering purposes. The coarse variety of crystallized diamonds is called bort, and as this is unfitted for gem purposes because of imperfections, it is ground into powder and used for cutting and drilling precious stones.

White sapphires, white zircons, white topaz, and rock-crystal sometimes pass for diamonds. The first two are heavier, the topaz lacks brilliancy, and the crystal is lighter than the diamond.

It is also the case that these four stones, especially the crystal, are easily scratched by a diamond.

The best style of cutting for a diamond is the brilliant, of 66 facets, including the table and culet. The proper proportions of a well cut brilliant is $\frac{1}{3}$ for the crown and $\frac{2}{3}$ for the collet. The table and culet must also be in proportion to the size of the stone.

Corundum.

This many-colored mineral, composed of nearly pure alumina, produces gems which in some cases are more valuable even than diamonds. The ruby, sapphire, Oriental emerald, Oriental topaz, Oriental amethyst, Oriental aquamarine, Oriental chrysolite, Oriental hyacinth, star ruby, star sapphire, star topaz, and ruby and sapphire cat's-eyes are all corundums of different colors. The ruby is a red sapphire, and the Oriental topaz a yellow sapphire, while the Oriental emerald is a green sapphire, etc., etc.

In hardness corundum ranks next to the diamond, ranking No. 9 in Moh's scale.

The specific gravity is 3.9 to 4.1, the crystallization rhombohedral, and cleavage basal, the crystals breaking across the prism with nearly a flat surface.

In lustre, the corundum is vitreous, its refraction double but not to a high degree, and it is susceptible of electricity by friction, which the polished specimens especially retain for a considerable time.

Corundum is unaffected by chemicals, and is infusible alone, but in combination with a flux it melts with difficulty into a clear glass.

The chemical composition of precious corundum is:

Alumina,	98.5
Oxide of iron,	1.0
Lime,	0.5
	100.

Thus it will be seen that corundum is composed almost wholly of alumina,—one of the constituents of common clay, which, when colored by traces of metallic oxides, chrome, etc., produces a greater variety of precious stones of a high rank than any other mineral.

The Ruby.

The red sapphire or ruby is the most valuable of the corundum family, and when found of a good color, pure and brilliant, and in sizes of one carat and larger, it is much more valuable than a fine diamond of the same size.

Fine rubies larger than $1\frac{1}{2}$ to 2 carats are very rare, and when a fine stone from 3 to 5 carats is offered for sale, the price mounts into the thousands.

The color varies from the lightest rose tint to the deepest carmine ; that color, however, which has the greatest value is known in commerce as pigeon's blood, and is the color of arterial blood, or of the very centre of the red ray in the solar spectrum.

The imperfections in rubies, as in all corundums, consist largely of clouds, milky spots, and cracks. A perfect ruby is rarely met with, and a stone possessing brilliancy and the true color, even if slightly defective, is considered more valuable than an absolutely perfect ruby of an inferior color.

Rubies are found in Siam, Ceylon, Burmah, Brazil, Hindustan, Borneo, Sumatra, Australia, France, and Germany.

Where rubies and sapphires are met with it is said that gold is almost sure to be present.

Chemists have succeeded in producing minute crystals of rubies and sapphires which, under the microscope, presented the true crystallization of corundums, and upon being tested proved to be of the same hardness as rubies and sapphires; but these specimens were small, and cost very much more to produce than their commercial value.

Ruby spinels, garnets, hyacinths, red quartz, burnt Brazilian or rose topaz, and red tourmaline are sometimes passed off for the ruby.

The true ruby will scratch all of these stones readily, the spinel is lighter in specific gravity, and has generally a slight tinge of yellow, even in the most pronounced red specimens.

The ruby will turn green under the flames of a blow-pipe, but when cooled off, resumes its original color.

The garnet and topaz are easily scratched by the ruby, the hyacinth is heavier, and quartz and tourmaline lighter than the

ruby. Some so-called reconstructed rubies, recently offered for sale, are of a very fine color, and closely resemble the Oriental gems.

The hardness and specific gravity are the same, but they differ in one very important point, namely: they lack the brilliancy of the true ruby. In addition to this lack of fire, a microscopical test discloses formations which will distinguish the manufactured from the natural stone.

Sapphire.

The blue corundum, ranging in color from the lightest blue to deep blue and black, is the same stone as the ruby, the only difference being in the color.

The choicest color is the soft velvety blue, approaching the corn-flower in shade and exhibiting that color vividly by artificial as well as by natural light.

The deeper-colored stones are known as male, and the light-colored ones as female sapphires.

Although choice sapphires are rare, a much greater quantity of good and large stones are to be had than of rubies, and therefore the price of a large sapphire does not advance in the same proportion as the price of a large ruby.

Fancy Sapphires.

The Oriental emerald or green sapphire does not approach the beryl or true emerald in depth of color, but because of its superior hardness and brilliancy, added to its extreme rarity, it is the most valuable of green gems. The Oriental amethyst or purple sapphire sometimes reflects a red color by artificial light, and is valued highly as a gem stone ; the common amethyst is softer, less brilliant, and loses by artificial light.

The various other colored sapphires, such as yellow or Oriental topaz, light green or Oriental aquamarine, greenish-yellow or Oriental chrysolite, and aurora-red or Oriental hyacinth, are all valuable

as gem stones when they are pure, well cut, and have pronounced colors—in fact, the name Oriental is given to distinguish the corundums from the less valuable minerals of the same colors which they resemble, but which they greatly surpass in beauty and value because of their brilliancy and superior hardness.

Star Sapphires.

Asterias or star stones are corundums of three different colors; the star sapphire proper is a grayish blue, the star ruby red, and the star topaz yellow.

These stones are usually cut cabochon or convex, and display under the rays of the sun, or when exposed to one candle or other artificial light, a beautiful star with six points.

This star is produced by foreign substances in the corundum, and the lapidary brings about the regular effect by cutting a pointed carbuncle so that the centre of the star begins at the apex, and the six

bright stripes radiate to the base of the stone.

The bright lines of the star following the light move over the surface of the stone and produce a remarkable effect. These stones are amongst the most wonderful of mineral productions, and good specimens are very valuable.

The corundum cat's-eye, called Oriental girasol or sunstone, has a bluish, reddish, or yellowish reflection of light of a lighter shade than the stone itself, and which moves on the convex surface of the stone like the lines of a star stone.

Spinel.

It is only during the past century that mineralogists make a distinction between the minerals spinel and corundum.

The composition of the spinel was discovered towards the end of the last century, and was found to be about seventy per cent. alumina, twenty-five per cent. magnesia, and small parts of oxide of chrome, silica, and protoxide of iron.

Up to that time, red spinels had always been confounded with rubies, and many celebrated so-called rubies have been shown to be spinels by modern mineralogists.

This beautiful mineral is found in many colors, from pink to rose-red, carmine, cochineal, blood-red, hyacinth, pale to dark blue, violet and indigo blue, grass-green to blackish green, and sometimes colorless. There is also a black variety called pleonaste or ceylonite. Spinels crystallize in octahedrons and their modifications, the fracture is conchoidal, specific gravity 3.5 to 3.6, and hardness No. 8 in Moh's scale ; only the diamond, corundum and chrysoberyl will scratch the spinel.

Its refraction is single, the lustre highly vitreous, and it does not easily acquire electricity.

Acids do not attack the spinel, nor has the blow-pipe any effect on this mineral, except to change the red to a brownish or colorless state, but the original color returns when the stone cools.

Flawed or imperfect stones are liable to crack or split if heated too much. With borax or salt of phosphorus the spinel melts into a colorless or green-tinted glass.

Spinels are found in clay and in the sands of rivers, in East India, Hindustan, the province of Mysore, Farther India, Pegu, Ceylon, North America, Sweden, Bohemia, and Australia.

The red spinel, and especially those tints which approach the red corundum or true ruby in color, are the most valuable, and are known as ruby spinels.

Very fine specimens of ruby spinels of one carat and larger are quite rare and command good prices.

Rose-colored spinels are known as balas-rubies, pale-blue spinels as sapphirines, and the hyacinth-red, yellowish-red, and orange-yellow spinels are called rubicelles.

All these different-colored spinels, if pure and of great brilliancy, are valuable as gem stones, being only surpassed in

hardness and brilliancy by the diamond and corundums.

The white spinel, which is seldom found, is sometimes confounded with the diamond, having the same specific gravity and single refraction, but as it lacks the fire and is easily scratched by the diamond, the danger of mistaking one for the other is slight. Burnt amethyst, which often resembles the spinel, is lighter and softer, while burnt topaz, although it is identical with the spinel in hardness, is somewhat lighter and possesses remarkable electric powers, becoming electric by either rubbing, heating, or pressure, and retaining electricity for upwards of twenty-four hours.

The zircon is easily distinguished from the spinel because of its much greater specific gravity. It is also doubly refractive and softer.

Garnets are softer, lack the play of color and brilliancy, and fuse easily into a light-brown or black glass.

Beryl.

The beryl is a mineral belonging to the primitive formation, and is found in quartz veins and granite.

It crystallizes in six-sided prisms and is composed largely of silica, the third most common of earth's productions. The beryl is 7.5 to 8. in hardness, scratching quartz, but is scratched by topaz.

The specific gravity is 2.67 to 2.73, making it one of the light minerals. Its lustre is vitreous and refraction double to a slight degree; its cleavage is imperfectly basal, and it becomes electric by rubbing.

Acids do not attack the beryl, but it melts with borax and is soluble in salts of phosphorus.

This stone is found in various colors, grass-green, pale-green, light-blue, greenish-blue, greenish-yellow, yellow, and sometimes pink.

The most important of these colors is the grass-green, which forms a separate

division of the beryl family, and is known as the emerald.

EMERALD.

The emerald or green beryl is one of the most highly prized of the gem stones. Its magnificent color has rightly been compared to the color of the fresh grass in spring, and in brilliancy this stone far exceeds all other green gems, excepting only the very rare green corundrum or green sapphire.

The emerald is said to be very soft when first withdrawn from the mine, but it hardens by exposure to the air.

A perfect emerald of fair size is a rarity, so that the saying "an emerald without a flaw" has passed into a proverb.

This stone is so light, compared to a diamond or sapphire, that a carat emerald will be very much larger than either of the above stones.

The emerald is composed of :

Silica	. . . . .	68.50
Alumina	. . . .	15.75
Glucina	. . . . .	12.50
Peroxide of iron	. .	1.
Lime	. . . . .	0.25
Oxide of chrome	. .	0.30

And traces of magnesia, of lime, and of soda.

The vivid green color of the emerald is supposed to come from the oxide of chrome, as the other beryls do not contain chrome.

Emeralds are found in New Granada, near Bogota, Egypt, East India, Burmah, Ural in Europe; Salzburg, Austria; Mt. Remarkable, South Australia; and North America. Some of the finest come from the mines of Muza, near Bogota, and the best stones are called Peruvian emeralds. During the conquest of Peru by the Spaniards, many very fine emeralds were destroyed by the invaders, who tested them by grinding and pounding, and concluded that the emeralds were worthless, because they were not as hard as the diamonds or sapphires.

In 1587, Joseph D'Acosta returned to Spain with two cases of emeralds, each case weighing one hundred pounds.

Green tourmaline sometimes passes for the emerald, but it is somewhat softer and considerably heavier.

Olivines or chrysolites, if of a fine green color, sometimes resemble the emerald, but they are much heavier than the emerald and have a fatty lustre. Green spinels are heavier and harder than emeralds.

Beryl.

The second and less valuable division of the beryl family comprises the following colors:

Clear light sky-blue, called by lapidaries aquamarine; very light greenish-blue, known as Siberian aquamarine; and a greenish-yellow variety, called aquamarine chrysolite.

These three kinds are usually very brilliant, and especially so by artificial light, in which respect the beryl is superior to

many of the more valuable gem stones. Beryls of very large size have been found in New Hampshire, one of which has been estimated to weigh over two tons. While the large specimens are worthless for gem stones, some very handsome aquamarines and golden-yellow beryls have been found during the past few years in New Hampshire and Connecticut. These stones, when cut, compare favorably with the best of their kind.

Chrysoberyl.

The name chrysoberyl is derived from two Greek words signifying golden-beryl. This name is well suited to the golden-yellow variety, but the chrysoberyl also includes many other colors : such as green, greenish-yellow, brownish-yellow, white, and dark-brown to black.

Three varieties of chrysoberyls are known as cat's-eyes, cymophanes, and alexandrites.

The chrysoberyl crystallizes in the

trimetric or rhombic system; the cleavage is imperfect; fracture conchoidal; hardness, 8.5, being the third hardest stone; specific gravity, 3.65 to 3.8; and lustre vitreous to greasy.

The composition of the chrysoberyl is: alumina, 80.2; glucina, 19.8; with traces of protoxide of iron and oxides of lead and copper. The chrysoberyl is doubly refractive to a high degree, acquires positive electricity lasting several hours, is infusible alone, but melts with borax or salts of phosphorus to a clear glass, though with difficulty.

The chrysoberyl is unaffected by acids, but with a solution of cobalt nitrate the powdered mineral becomes blue.

Transparent greenish-yellow chrysoberyls are sometimes called Oriental chrysolites. These, and the brownish-yellow stones are the gems most used in jewelry.

The chrysoberyl cat's-eye, or Ceylon cat's-eye, is found in various shadings of

yellow, brown, and green, and sometimes nearly black. These stones are translucent to opaque, and have a bright band of light running through the centre. This band is nearly always white, and in fine specimens is sharply defined, not too wide, and is in the centre of the stone.

The cat's-eye chrysoberyls are always cut convex or cabochon shape, and as the stone is moved from side to side the band of light moves over its surface.

CYMOPHANE.

The cymophane, or floating light, as the name denotes, is a chrysoberyl with a bright spot of light which seems to float over the surface as the stone is moved. The cymophane is also cut cabochon.

ALEXANDRITE.

On the day that the Emperor Alexander of Russia attained his majority the Ural chrysoberyl, of a dark-green color,

was found in the emerald mines of Takowaja in the Catherine Mountains.

This wonderful stone is emerald-green to dark-green in color, with often a slight red tint, but by artificial light the green of good specimens changes to a beautiful columbine-red.

As the colors green and red are the national colors of Russia, and the date of discovery of this stone in Russia occurred on the Emperor's birthday, the name alexandrite was given to this species of chrysoberyl.

The alexandrite is found in large pieces, but is nearly always flawed and cracked. This is a much-sought-after gem stone, and specimens of from one to five carats command good prices. Up to the present time, however, good alexandrites have been rare, and the demand has always exceeded the supply.

Cat's-eyes and cymophanes are found in Brazil in alluvial deposits of rivers, and consequently in rolled and rubbed masses.

Chrysoberyls are also found in Russia, Germany, America, Borneo, Pegu, and Moravia.

Chrysolites and topazes are sometimes passed off for chrysoberyls. The chrysolite is, however, lighter and softer, while the topaz becomes electric from heating, and is softer.

Quartz cat's-eyes, which are mistaken for chrysoberyl or Oriental cat's-eyes, have a specific gravity of about 2.65, hardness of 6 to 6.5, and are soluble in fluoric acid, besides melting with soda into a clear glass.

They lack the bright, hard polish of the chrysoberyl cat's-eye, and there should be no difficulty in discovering the difference between the gem and the inferior stone.

ZIRCON.

The zircon, hyacinth, jacinth, or jargoon belong to the tetragonal system of crystallization. The cleavage is imperfect,

fracture conchoidal, and specific gravity 4.4 to 4.7, the stone being much heavier than any other gems. Its hardness is 7.5 and lustre vitreous to adamantine, and refraction double to a high degree.

The zircon is phosphorescent when heated; before the blow-pipe it is infusible, but loses its color; and with borax it melts into a transparent glass. Sulphuric acid affects this gem after long maceration.

The composition of the zircon is: zirconia, 66.3; silica, 33.7; with a trace of peroxide of iron.

Under the microscope, the texture of these gems presents a watery appearance, called by the French *ratiné*, and which looks like a liqueur poured into water. This is a strong distinguishing point in the zircon.

The zircon, hyacinth, jargoon, and jacinth are the same gems but of different colors.

The brown, violet, and green colors are known as zircons, the red as hyacinth, the

yellow as jacinth, and the grayish-white and white as jargoons.

The jargoon has often been palmed off as a diamond because of its transparent color and adamantine lustre.

The zircon is found in Ceylon, Germany, France, Bohemia, America, and in fact in nearly all parts of the earth, as many as 120 localities having been noted where specimens of the mineral have been discovered.

The zircon can be distinguished from the garnet by its peculiar diamond-like brilliancy and its specific gravity.

Turquois.

The turquois is never found in crystals, but in reniform or stalactitic masses. The color varies from pea- and apple-green to greenish-blue, sky-blue and dark-blue.

The hardness of the turquois is 6., specific gravity 2.6 to 2.8, lustre waxy, and condition opaque to slightly translucent.

Before the reducing flame of the blowpipe, the turquois does not melt, but becomes brown and colors the flame green. With borax and salts of phosphorus the turquois melts to a clear glass, while it is also soluble in hydrochloric acid. Oriental or mineral turquois is composed of:

Alumina	47.45
Phosphoric acid . .	27.34
Water	18.18
Oxide of copper . .	2.02
Iron	1.10
Oxide of manganese .	0.50
Phosphate of lime .	3.41
	100.00

The best color is a clear deep sky-blue, and in the true turquois this color improves by artificial light; imitation turquoises, however, lose their fine color under the same conditions.

The finest gem turquoises come from the northeastern part of Persia, between Nishapoor and Meshed. Here they are mined and partly cut, and then the Persian merchants carry them to Russia, where

they are sold at the great annual fair of Nijni-Novgorod and in Moscow. Mineral turquoises are also found in New Mexico, Arizona, and Nevada, but not of sufficient size or sufficiently good color to make gem stones, although they are prized for collections. Specimens are also found in Burmah, Khorassan, Thibet, China, Silesia, Saxony, and on the Isthmus of Suez. The stones from these places have, as a rule, but little value, as the color fades or turns green from exposure to the light. Of late however, some very good turquoises have come from Egypt. The color of a faded Persian turquois can sometimes be restored by simply repolishing the stone.

Occidental or bone turquoises called new rock or odontolites, to distinguish them from the Persian or old rock stones, are of organic origin.

They are cut from the teeth of mammoths, mastodons, dinotheriums, etc., and are found near the town of Simor, in Lower Languedoc, France.

These teeth, the enamel of which is nearly as hard as the mineral turquois, are colored by contact with phosphate of iron and copper, which gives them a dark-blue, light-blue, and bluish-green color. They are easily attacked by a file, and totally destroyed by aqua-fortis.

When heated, the fossil turquois or odontolite gives an offensive odor, owing to the decomposition of animal matter.

The odontolite is lighter than the mineral turquois, changes color by artificial light, loses color in distilled water and alcohol, and is translucent on the edges.

This fossil turquois does not fade like the mineral turquois, but by artificial light appears of a dirty grayish-blue.

Turquoises are sometimes artificially stained, but this can be detected by applying a drop of ammonia to the back of the stone, and if the color is artificial the ammonia will eat it off, leaving a green spot. Ammonia does not affect the color of the Persian turquois. The so-

called "reconstructed" turquoises are very close imitations of the real, but are easily distinguished, as they change rapidly to a deeper blue when immersed in water, and while wet the surface of the stone shows cracks in every direction. These stones become softer through soaking in water or alcohol. The original color, however, returns when the stone is dry, but the cracks remain in faint outline.

TOURMALINE.

The tourmaline or precious schorl is known under many different names, and no other mineral has such a suite of colors. The colorless variety is known as achroite; the red, as rubellite or siberite; the blue, indicolite or Brazilian sapphire; the green, Brazilian emerald; and the yellowish-green, Ceylon chrysolite or Ceylon peridot. Besides the above colors and their shadings, the tourmaline occurs in black and brown.

The crystallization is obtuse rhomboid, and generally forms six-, nine-, and twelve-sided prisms.

Some of the crystals are very large, specimens over eight inches long having been mined.

The tourmaline crystals are remarkable for their varied and beautiful groupings of colors. Some are internally blue or brown, surrounded by a bright carmine red or dull yellow; others are red internally and are enveloped by a green exterior; crystals are sometimes pink at the summit and light green at the base, or crimson tipped with black, or white at one end shading into green and finally into red at the other end. The hardness of the tourmaline is 7 to 7.5, specific gravity 3 to 3.1, and lustre vitreous.

The tourmaline becomes decidedly electric by heating or rubbing, and will readily attract small pieces of paper and other small objects. The rubellite or red tourmaline is composed of:

Silica	42.13
Alumina	36.43
Boracic acid	5.74
Oxide of manganese . .	6.32
Lime	1.20
Potash	2.41
Lithia	2.04

The green tourmaline is composed of

Silica	40.
Alumina	39.16
Lithia and potash . . .	3.59
Protoxide of iron . . .	5.96
Protoxide of manganese .	2.14
Boracic acid	4.59
Volatile matter	1.58

The tourmaline possesses double refraction to a high degree, and its power of polarizing light is so great that, cut into slices, it is used in the polariscope for analyzing other minerals.

If two slices of tourmaline, cut parallel to their axis, be laid one on the other in one direction, both are transparent; if laid in another direction they become opaque, and if a doubly refracting crystal be placed between the two plates of

tourmaline, the part covered by the crystal is transparent while the other is opaque.

Tourmaline melts with borax into a transparent glass; the rubellite turns white, and the indicolite and green tourmalines turn black, under the blow-pipe.

Tourmalines can be distinguished from other gems by their specific gravity, but principally by their property of assuming polaric electricity after being heated, one end becoming positive and the other negative.

The history of the discovery of the tourmaline and its electric property is a curious one.

On a warm summer day, early in the eighteenth century, some children were playing in a courtyard in Amsterdam. Amongst their playthings were some precious stones which the Dutch navigators had brought from Ceylon. Some of the stones seemed to be possessed of the strange power of attracting and repelling small bits of straw, ashes, and other light substances. The little ones called their

parents to witness this strange phenomenon, and the stolid Dutch lapidaries, themselves puzzled at the sight, called the stones *aschentreckers* or ash-drawers.

A number of years afterwards, careful experiments disclosed the wonderful electric powers of the aschentreckers or tourmalines. Purple, green, and blue tourmalines are found in Brazil. In Ceylon the stones are found in gravel beds. Rubellites or siberites are found in Siberia.

Tourmalines are also found in Moravia, the island of Elba, Sweden, Burmah, Tyrol, Canada, and the United States.

The first tourmaline deposits known in the United States were discovered at Paris, Maine, in 1820. Another wonderful deposit was found at Mt. Apatite in Maine in 1882, and up to the present time the finest tourmaline crystals have been discovered in the United States.

Really fine specimens of red, blue, or green tourmalines are uncommon and command very good prices.

OPAL.

The precious or noble opal, fire opal, common opal, hydrophane, and cachelong are different varieties of a mineral that is composed of about nine parts silica and one part water.

The colors vary from chalky-white to bluish-white, from yellow to red, and from a slight play of colors to the beautiful mingling of green, blue, and red with the most remarkable kaleidoscopic effects.

The opal is 5.5 to 6 in hardness, specific gravity 2 to 2.1, lustre glassy, and translucent from a slight to a very high degree.

The opal is found in an amorphous state and never crystallizes; in fact from the condition of the pockets in which this mineral is found, the indications are that the substance was once a fluid.

Under the blow-pipe the opal loses its translucency and cracks but does not melt. Sulphuric acid will cause it to turn black, and in a cold solution of caustic potash the opal is almost entirely soluble.

The precious or noble opal is found chiefly in the mines of Czernowitza, between Kaschau and Eperies, in Hungary, and in Gracias á Dios, a province in Honduras.

In olden times, the Greek and Turkish merchants carried opals from Hungary to the Orient, and then they were shipped to Holland and sold in Europe as Oriental opals.

The fire opal is of a yellowish-red color, and is found chiefly in Mexico, although it also occurs in Hungary, the Faroe Islands, Honduras, and Guatemala.

The common opal is found in Ireland, Denmark, Frankfurt, Guatemala, and South Australia, and also in Hungary and Mexico. These opals are translucent without fire or reflection.

The hydrophane is an opal that has lost color and brilliancy by reason of the evaporation of its water. If placed in water or alcohol, this stone becomes transparent, only to lose this quality when the water or alcohol has evaporated.

The hydrophane becomes transparent more quickly in warm than in cold water, but most rapidly in alcohol. If boiled in oil, the hydrophane is said to retain its brilliancy for years.

The cachelong is milky-white, and nearly opaque, and is found in small masses in the river Cach, in Bucharia, and also in Iceland.

Although one of the most magnificent of the gem stones, the opal for many years was under the ban of superstition. Now, this splendid stone once more commands a foremost place in the jewelers' art, and the opal mines of Hungary and Queensland are being worked to their fullest extent to supply the demand.

PEARL.

Although an organic product, the pearl is always ranked amongst the most precious of gems, and is distinguished by being the only gem that does not require the lapidary's touch to bring out its beauties.

Ancient writers have accounted for the origin of pearls by saying that they were formed of angels' tears, or drops of dew from heaven, which, during the midsummer nights, fell into the gaping mouths of the pearl-oysters.

According to modern scientific investigation, the formation of the pearl does not seem to be the result of healthy natural causes, but comes from the efforts of the oyster to rid itself of some foreign substance, like a grain of sand, a bit of shell or vegetation, or some unwelcome visitor in the shape of a small water insect.

When annoyed by an intruding substance, the oyster begins to deposit its nacre, or mother-of-pearl, in regular concentric layers around the intruder, these layers gradually increasing in circumference and forming the pearl. Thus, like an onion, the pearl is merely a succession of layers or skins, starting from a small core, or nucleus, which is always present, though often only of microscopical size.

Pearls have sometimes been found where the outer layer, or skin, as it is technically called, has been discolored or otherwise injured, and when this top skin has been carefully removed the result was a somewhat smaller but perfect pearl.

This, however, is a very delicate operation, and at the pearling grounds is only resorted to by men of experience. The composition of the pearl is carbonate of lime, with a small proportion of organic matter, and the specific gravity 2.5 to 2.7.

The pearl is affected by acids, and is easily calcined on exposure to heat.

In color, the pure white, slightly transparent, is the most highly prized ; while in India and China the bright yellow colors are sought after.

Decided colors, however, such as black, pink, and golden-yellow bring a high price, and, in fact, black pearls, if perfect in color and shape, are at present more valuable than any other kind.

The beauty and value of a pearl depend on form, quality of texture or skin, color, transparency or water, and lustre or orient.

In form, the perfectly round shape comes first in value, then a finely formed drop or pear shape, and lastly the oval or egg shape.

Pearls that are flat on one side and rounded on the other are called boutons or button pearls. These are frequently found attached to the shell, and are cut out and the bottom part smoothed and polished.

It is easy, however, to detect this class of pearls by the lack of pearly lustre on the side that was attached to the shell.

When a pearl is rough and odd-shaped it is called a baroque, and some extremely fantastic shapes are found, especially in fresh-water oysters.

The texture or skin of a fine pearl should be perfectly smooth and free from all spots, indentations, wrinkles, or scratches.

Pure white is the desirable color for a gem pearl, but many others that are slightly tinted with blue, pink, or yellow will pass for gems if they are otherwise perfect.

The transparency or "water" of a pearl, while not existing in fact, is still one of the requisites of a fine pearl; there must be an appearance of transparency, which adds to the beauty of the gem.

To describe the lustre or orient of the pearl, the author can only use the term pearly, as there is no other substance that approaches the brilliancy and color of a pearl, excepting, of course, mother-of-pearl—the nacre in the pearl-oyster.

Without orient or lustre, the pearl of finest form and color has but little value.

Lustre is to the pearl what brilliancy is to the diamond; when the orient is absent there is no life, no beauty.

Pearls are principally supplied by two groups of pearl-oysters or mussels: the marine or meleagrina margaritifera, a

round-cornered square shell with very thick sides, measuring six to eight inches in length.

The color of this shell is mostly blackish-green, but it is also sometimes yellowish; the edges of the inner part of the shell are black, but the rest of the interior is the beautiful mother-of-pearl.

The oyster itself is small for the size of the shell.

This specimen is found on the coast of Ceylon, Persian Gulf, Japanese, Mexican and California coasts, the western shores of South America, Brazil, West Indian Islands, Panama, Sooloo Archipelago, and the northeast and northwestern coast of Australia.

The fresh-water or unio margaritifera is an even, egg-shaped mussel found in brooks, rivers, and lakes in temperate zones in nearly all parts of the world.

Some fine river pearls have been found in the United States, but most of the American pearls are of a button or elon-

gated shape, or are baroques or fancy-shaped.

In China many people engage in the business of making small pellets of clay or metal images, which in the month of May are introduced into the river mussels (mytilus cygneus).

The mussels are replanted, and in November they are taken up again. Some of the oysters die, but most of them are found to have been actively at work covering the little pellets or metal figures with nacre, and while no strictly first-class pearls are formed in this way, many curious little pearl figures or gods are made and sold to the curious or devout.

Pink or conch pearls are found in the Gulf of California and coasts of Mexico, Bahama Islands, West Indian Islands, and in some rivers in South America.

They seldom occur in regular shapes, and although they are termed pink pearls, they range in color from red to pale yellow, and are often found of a china-white color.

The pink pearl displays a wavy appearance and a peculiar sheen, something like watered silk. As the pink pearl is seldom found perfectly round and of a good color, such a specimen is very valuable.

CHRYSOLITE.

The chrysolite, peridot, and olivine differ in color, but are practically of the same composition.

The chrysolite proper is of a pale greenish-yellow color, the peridot a deep olive-green, and the olivine of a yellowish or light olive-green color; these stones also shade into brown. They crystallize on the rhombic system, are tranparent to translucent, 6.5 to 7. in the scale of hardness, and 3.3 to 3.5 in specific gravity.

The cleavage is distinct, fracture conchoidal, refraction double, and lustre vitreous, and in the olivines somewhat greasy.

These stones are easily affected by sulphuric acid, but are infusible before the

blow-pipe, excepting some kinds containing much iron.

With borax, they melt to a pale-green transparent glass.

Chrysolites are composed of silica, magnesia, and oxide of iron.

Perfectly crystallized chrysolites are brought from Constantinople, but the exact locality where they are found is unknown.

Less distinct specimens occur at Vesuvius, Mexico, the isle of Bourbon, Auvergne, Egypt, Natolia, Brazil, Germany, Pegu, Ceylon, Switzerland, and North America.

Peridots are distinguished by being the only precious stones that have literally dropped from heaven, as they have been found in meteorites.

The Oriental chrysolite of commerce is true chrysoberyl, and is harder and heavier than chrysolite, and the stone called Ceylon chrysolite is a greenish-yellow tourmaline, which is easily dis-

tinguished, as it is also harder while considerably lighter than the chrysolite.

The green garnet is of a pronounced green color, and is harder and heavier than the olivine or chrysolite. Although suitable for mounting in brooches and other ornaments, these stones are not sufficiently hard for the rough usage as ring-stones.

Garnet.

Almandine, almandite, Syrian garnet, essonite, cinnamon-stone, pyrope, Bohemian garnet, vermeille, Cape garnet, Cape ruby, Arizona ruby, American ruby, carbuncle, uwarowite, demantoide, grossularite, and Bobrowska garnet are some of the scientific and commercial names for different species and colors of the garnet group.

The crystallization of the garnet is isometric, refraction single, specific gravity 3.15 to 4.3, hardness 5 to 8, lustre vitreous, fracture uneven, colors red, violet, brown,

yellow, green, and white, and the various shadings of these colors.

Most varieties fuse easily to a brown or black glass; the uwarowite fuses with borax to a clear chrome-green glass.

Syrian, almandine, almandite, and carbuncle are different names for the iron-alumina garnet.

In colors, these stones shade from deep-red to violet and brownish-red, and are composed of:

Silica	36.01
Alumina	20.06
Protoxide of iron	43.03

The specific gravity is 4. to 4.2, and hardness 7.5.

This garnet, sometimes called the precious garnet, is found in Ceylon, Pegu, Brazil, Greenland, Hindustan, Bohemia, Tyrol, Œtzthal, Carinthia, Styria, Switzerland, Ariolo, Canaria, Maggia, Hungary, Sweden, Norway, Scotland, Spain, and the United States.

Grossularite, or lime-alumina garnet, is known in commerce as essonite, or cinnamon-stone. The color is yellow, of various shades; specific gravity 3.5 to 3.65, and hardness 6.5.

These stones are sometimes sold for jacinths, but they are softer than the jacinth, and melt easily before the blowpipe. Essonites come principally from Ceylon, but are also found in other places.

Pyrope or Bohemian garnet is the magnesia-alumina variety, and is of a uniform dark blood-red color. This stone is found in Bohemia, and although quantities of small pieces are found, large specimens are rare, and a piece that will cut into a four- or five-carat stone is seldom met with and commands a high price.

These garnets are found at Stiefelburg by Meronitz, Triblitz, Podsedlitz, and Neupaka.

The pyrope turns black under the blowpipe, then red again, and melts with difficulty into a black glass. With borax it

melts to an emerald-green glass. The specific gravity of this garnet is 3.69 to 3.78, and hardness 7.5.

Vermeille is a name given to the orange-red almandine, Cape garnet to the bright red-yellow variety, Cape ruby to the pyrope, and American ruby tc the blood-red kind found in New Mexico, Montana, and Arizona. Carbuncle is a term applied *to all* garnets cut with a smooth rounding top, sometimes called, after the French, cabochon.

Uwarowite or lime-chrome garnet is one of the rarest and most beautiful of the garnet group.

The color of this stone is emerald-green, hardness 7.5, and specific gravity 3.41 to 3.52. Uwarowites are found near Bissersk in the Urals of Russia, but rarely in specimens of sufficient size to cut into gems.

This garnet is heavier and harder than the true emerald.

Demantoide or Bobrowska garnet is a soft garnet, olive-green to brown and

blackish-green in color, sometimes light green. It is found in the Bobrowska River in the Urals. The specific gravity is 3.85, and hardness about 6, its softness making it undesirable for many ornaments. Before the blow-pipe it fuses into a black bead.

These garnets are often sold as olivines; they are heavier than olivines and softer.

Demantoide is composed of:

Silica	35.44
Lime	32.85
Sesquioxide of iron	32.85
Magnesia	.20

TOPAZ.

Topaz belongs to the rhombic system of crystallization. Its cleavage is basal and perfect, fracture uneven, hardness 8, scratching quartz distinctly, specific gravity 3.4 to 3.6, lustre vitreous, refraction double, and colors ranging from colorless or white to bluish-white, light blue, wine-yellow, straw-yellow, golden-yellow, greenish- and pale-red to pink.

Topaz becomes electric from rubbing or pressure, and retains electricity for twenty-four hours. Before the blow-pipe topaz partly loses color, but does not melt, and with borax it fuses slowly to a white bead.

Topaz is partially attacked by sulphuric acid, and dissolves in salts of phosphorus.

The composition of topaz is:

Silicon	15.05
Aluminium	30.02
Oxygen	36.08
Fluorine	17.05

Goutte d'eau or colorless topaz, sometimes called "slaves diamond," Siberian or bluish-white, Brazilian or golden to reddish-yellow, Saxony or pale-wine yellow, Brazilian ruby or pink, Brazilian sapphire or light blue, and aquamarine or greenish, are the various commercial names for topaz.

Most of the Brazilian rubies or pink topazes are produced by heating the reddish or dark-yellow variety, either in a crucible or by enveloping the stone in

German tinder and setting fire to the tinder. If heated too much, the stone is apt to become colorless, and if suddenly cooled it may crack.

Colorless or white topaz takes a very high polish, and is wonderfully clear and transparent.

The great Portuguese diamond, "The Braganza," of about 1,680 carats, is supposed to be a white topaz.

Topaz is found in the Urals, Kamschatka, Alabaschka, Miask, Nestschinsk, Adun Tschilon, Villa Rica, Boa Vista, Capao, Lana, Minas Novas, Cairngorm Mts., Schlackenwald, Zinnwald, Schneckenstein, Ehrenfriedensdorf, Altenburg, Orenburg, Mourne Mts.—Ireland, Australia, New South Wales, Ceylon, Mexico, and the United States. False topaz, or the ordinary topaz of commerce, is yellow quartz resembling yellow topaz, but lacking its brilliancy and hardness; it is also very much lighter, being only 2.5 to 2.7 in specific gravity.

Beryl and chrysolite are often mistaken for topaz, but as they are softer and beryl is much lighter, they are easily distinguished from the topaz. The strong electric property of the topaz is also a conclusive test.

Oriental topaz, or yellow corundum, is harder and heavier than the occidental or true topaz.

Apatite.

Apatite, which is seldom used as a gem stone, sometimes resembles the beryl and emerald, but is much softer and rarely has the color and brightness combined of the former gems.

This mineral, composed principally of subsesquiphosphate of lime, is 4.5 to 5. in hardness, has the specific gravity of 2.95 to 3.25, is transparent to opaque, vitreous in lustre, infusible before the blow-pipe, and dissolves slowly in nitric acid. In colors, apatite varies from colorless to sea-

green, bluish-green, violet-blue, gray, yellow, red, and brown.

Apatite is found in Saxony, the Hartz Mts., Bohemia, Norway, Bavaria, England, St. Gothard in Switzerland, and in the United States.

Felspar.

Four varieties of felspar are used as gem stones—moonstone or orthoclase, sunstone or avanturine felspar, Amazon stone or green felspar, and Labrador or Labrador spar.

Moonstone.

This variety of felspar is called orthoclase, adularia, and orthose, besides the commercial names of fish-eye, Ceylon or water opal, and in the yellow and red tints sunstone. Moonstone occurs in crystals and crystalline fragments, also massive and granular; its hardness is 6. to 6.5, specific gravity 2.4 to 2.6, refraction double, is not attacked by acids, and is composed of:

Silica	64.5
Alumina	18.5
Potash	17.

With traces of soda.

This beautiful stone is the clearest of all varieties of felspar. It is colorless, or only slightly tinted with blue, green, yellow, and flesh-red, and is transparent to translucent.

The lustre is vitreous, and a brilliant pearly streak of white light plays from side to side.

The yellowish- and reddish-tinted specimens are called sunstones, and are quite rare. These sunstones must not be confounded with the avanturine or felspar sunstone.

Moonstones are found principally in Ceylon and on the St. Gothard in Switzerland, but also occur in Bavaria, Greenland, Tyrol, Dauphine, Norway, and the United States.

During the past few years, large quantities of moonstone balls, cut like whole pearls, have been used for jewelry—the

stones being much sought as well because of their beauty as on the ground of the popular superstition that they will bring good luck to the wearer.

Small pieces or balls are not very valuable, but large perfect specimens command a good price.

SUNSTONE.

(AVANTURINE FELSPAR.)

Sunstone or avanturine felspar is a variety of oligoclase; grayish-white to reddish-gray in color, usually the latter; containing minute crystals of hematite, göthite or mica, which are imbedded and scattered through the stone, and give forth golden-yellow, reddish, or prismatic reflections. The hardness is 6 to 7, specific gravity 2.56 to 2.72, and lustre pearly or waxy to vitreous.

Sunstones are found near Stockholm, in Finland, the Urals, Ceylon, the Alps, Iceland, the United States, and other places.

Amazon Stone.

(GREEN FELSPAR.)

The Amazon stone is a green variety of felspar, which was first found on the banks of the Amazon River, but now comes from Siberia and the United States. This stone consists of potash, alumina, and silex—is green in color but rarely clean, being discolored in places and usually covered with small white spots.

The Amazon stone is harder than glass, but is scratched by rock crystal. Its specific gravity is 2.5 to 2.6; acids do not affect it, and it melts with difficulty before the blow-pipe.

Labradorite.

Labrador stone or labradorite is sometimes known as opaline felspar, and was first discovered on the island of St. Paul on the coast of Labrador.

Labradorite is translucent to opaque, gray-green or brown in color, and has

beautiful chatoyant reflections of brilliant blue, sea-green, and sometimes red and yellow, changing from one color to another. Labradorite is 6 in hardness, has a specfiic gravity of 2.62 to 2.76; a vitreous to pearly lustre, is brittle, fuses with difficulty before the blow-pipe, and is decomposed by muriatic acid. It is composed of:

Silica	52.9
Alumina	30.3
Lime	12.3
Soda	4.5

Large masses of this stone are found on the coast of Labrador. It is also found in Finland, Russia, and the United States. Because of the dark chatoyant appearance the name of œil de bœuf or ox-eye is sometimes applied to labradorite. Handsome specimens, cut cabochon, form pretty ring stones, and many effective engraved cameos have been produced by using the bright portion for the relief work and the gray dead part for the base.

CYANITE.

This stone is the transparent variety of disthene, and is sometimes commercially known as sappare. Cyanite is colorless to bluish-white, sky-blue, berlin blue, yellowish- and reddish-white, gray, and green.

The hardness is 5 to 7, specific gravity 3.45 to 3.70, lustre vitreous and pearly; it is infusible before the blow-pipe, but fuses with borax; is not attacked by acids, and is composed of:

Silica	36.8
Alumina	63.2

Cyanite is found in Switzerland, the Tyrol, Styria, Carinthia, Bohemia, Norway, Finland, France, South America, Scotland, Ireland, Siberia, the East Indies, and the United States. Clean specimens are not plentiful, and fine blue pieces have frequently been sold for sapphires. The cyanite can be distinguished from the sapphire by its inferior hardness and lighter weight.

Lapis Lazuli.

Lapis lazuli, the sapphire of the ancients, is a mineral, translucent to opaque, ranging in color from colorless to an azure-blue, violet-blue, green, and red.

The principal color, however, is a rich, azure blue, sometimes shading into green, and having a vitreous to greasy lustre.

Its hardness is 5 to 5.5, specific gravity 2.38 to 2.42; it is decomposed by muriatic acid, and fuses before the blow-pipe to a white glass. It is rarely found clean, but has usually a number of veins and spots of a metallic nature. It is composed of:

Silica	45.
Alumina	31.76
Soda	9.09
Lime	3.52
Sulphuric acid	5.89

and traces of iron, soda, and potash.

This mineral is found in Siberia, Transylvania, Persia, China, Thibet, Tartary, South America, India, and Brazil.

Lapis lazuli is sometimes employed for jewelry, and was for some centuries ground

up and used to make the mineral paint known as genuine ultramarine. This paint is now produced chemically, and the more costly mineral compound is rarely used.

The imitation of lapis lazuli for jewelry purposes is also very easy, as metal filings can be readily introduced into the azure blue glass, and thus an imitation of the genuine stone produced, which is perfect except in hardness.

HIDDENITE.

The hiddenite is a variety of spodumene that has only been found in one locality, namely Alexander County, North Carolina. This mineral was discovered by W. E. Hidden, and has been named after him.

The hiddenite is perfectly transparent, and varies from a pale yellowish- to a deep emerald-green, being very brilliant, and approaching the emerald in color. As this stone is rarely found large enough for cutting into gems, it is highly prized and good specimens command a large price.

The hardness of the hiddenite is 6.5 to 7, and specific gravity 3.13 to 3.19; before the blow-pipe it melts to a clear glass, and it is attacked by salts of phosphorus. It is composed of:

Silica	64.35
Alumina	26.58
Lithia	7.05

with traces of iron and soda.

SPODUMENE.

Spodumene is sometimes cut and polished as a gem, but its peculiar cleavage makes it a bad stone for the lapidary to cut and the jeweler to mount.

Its hardness is 6.5 to 7, specific gravity 3.13 to 3.19, and lustre, vitreous to pearly.

Grayish-green, greenish-white, and sometimes yellow or faint red are the colors. Its composition is:

Silica	64.2
Alumina	29.4
Lithia	6.4

Acids do not attack spodumene, and under the blow-pipe it fuses to a white glass.

This mineral is found in Sweden, the Tyrol, Ireland, Scotland, and the United States.

DICHROITE.

Dichroite is sometimes known under the mineralogical names of cordierite and iolite, and commercially as *saphir d'eau*, or water sapphire. This stone is remarkable for pleichroism, sometimes showing three different colors in as many directions, and when properly cut has often the star formation of the corundum star-stones.

Water sapphire, as the blue specimens are called, is 7 to 7.5 in hardness, specific gravity 2.56 to 2.67, transparent to translucent, and frequently full of flaws. It is partially decomposed by acids, melts with difficulty before the blow-pipe, is vitreous to greasy in lustre, and is composed of:

Silica	49.
Alumina	32.
Ferrous oxide . .	7.
Magnesia	9.

Besides the *saphir d'eau*, which is blue, dichroite occurs colorless, bluish-white, yellowish-white, yellowish-gray to yellowish-brown, indigo to blackish-blue, and violet. This mineral is found in Ceylon, Spain, Norway, Sweden, Tuscany, Greenland, and Bavaria. Sapphire is harder and much heavier than dichroite.

IDOCRASE.

Idocrase or vesuvianite was first found amongst the ancient ejections of Vesuvius, and it is still found at Vesuvius in hair-brown to olive-green colors.

Vesuvianite is 6.5 in hardness, 3.35 to 3.45 in specific gravity, transparent to opaque, lustre vitreous to greasy. It possesses strong double refraction, is attacked by acids, and melts readily under the blow-pipe. Vesuvianite consists of:

Silica	37.75
Alumina	17.23
Sesquioxide of iron .	4.43
Magnesia	3.79
Lime	37.35

In colors, this mineral shades from brown to black, yellow, pale-blue, and green, and it is found at Vesuvius, Alps, Piedmont, Mt. Somma, Etna, Norway, Sweden, Spain, Hungary, Urals, and the United States.

Transparent or strongly translucent specimens, in handsome green or brown varieties, are used for jewelry, principally, however, in Turin and Naples.

Chrysolite and green garnet are sometimes substituted for vesuvianite. The first has a greater specific gravity and is more vivid in color, and the latter is also heavier and harder.

EUCLASE.

Euclase is very brittle, and therefore is rarely used as an ornamental stone.

This mineral has the hardness of 7.5; specific gravity, 3.1; lustre, vitreous to pearly; it is transparent to semi-transparent, doubly refractive, is not acted upon by acids, fuses under the blow-pipe to a white enamel, and is composed of:

Silica	41.2
Alumina	35.2
Glucina	17.4
Water	6.2

Euclase occurs in Brazil, in the neighborhood of Villa Rica, and also in the Urals, in colorless, pale green, blue, pale yellow, and white colors.

SPHENE.

Sphene or titanite is also a brittle mineral, 5 to 5.5 in hardness; specific gravity, 3.4 to 3.56; transparent, doubly refractive; lustre, adamantine to resinous; colors, brown, gray, yellow, green, black, and colorless; and composition:

Silica	31
Titanium oxide . . .	41
Lime	27
Ferrous oxide . . .	1

When transparent in colorless, greenish, or yellow colors, this mineral presents an appearance like the fire opal.

Sphene is found in Switzerland, the

Urals, Tyrol, Finland, Wales, Ireland, Germany, Canada, and the United States.

Phenacite.

This mineral, rarely used as a gem stone, is 7.5 to 8 in hardness; specific gravity, 2.96 to 3; lustre, vitreous; transparent to semi-translucent, doubly refractive, it does not melt before the blow-pipe, and contains:

Silica	54.2
Glucina	45.8

Phenacite occurs colorless, and also bright wine-yellow inclining to red, and brown. This stone is found in Russia, Mexico, and Alsace.

The colorless or transparent variety approaches the diamond in brilliancy, especially under artificial light.

Epidote.

Epidote usually occurs in a peculiar yellowish-green, called pistachio green, a color that is seldom found in other min-

erals. Besides this color, olive, brownish-green, greenish-black and black, red, yellow-gray, and grayish-white occur. The hardness of epidote is 6 to 7; specific gravity, 3.32 to 3.50; lustre, vitreous to pearly; refraction, double. The stone is transparent to opaque, is attacked by acids, and is slightly affected by the blow-pipe. It is composed of:

Silica	38
Alumina	22
Ferric oxide	15
Lime	23
Water	2

Epidote is found in Norway, Saxony, Siberia, Brazil, on the St. Gothard, in Switzerland, in the Tyrol, and in the Hartz.

AXINITE.

Axinite is a brittle mineral which has occasionally furnished some pretty gem stones.

The hardness of this stone is 6.5 to 7; specific gravity, 3. to 3.3; lustre, vitreous. It is transparent to translucent, is not at-

tacked by acids, and melts readily before blow-pipe. It is composed of:

Silica	43
Lime	20
Alumina	16
Ferric oxide	10
Borontrioxide	5
Manganese dioxide	3
Magnesia	2
Potash	1

Axinite occurs in clove-brown, plum-blue, and pearl-gray, and exhibits trichroism. The best specimens come from St. Christophe in Dauphiny, but it is also found at Santa Maria, and in Switzerland, Sweden, England, Chili, Saxony, the Hartz Mountains, and the United States.

Axinite is usually cut, like the opal, cabochon, but is rarely used as a gem stone.

Diopside.

Diopside is cut and sometimes sold in Turin and in Chamouny as a gem stone, but no great quantity of this mineral is used for ornamental purposes.

The hardness of diopside is 5 to 6; specific gravity, 2.9 to 3.5; lustre, vitreous to greasy. It is transparent to translucent, brittle, cannot be dissolved by acids, and melts before the blow-pipe. It is composed of:

Silica	54
Lime	24
Magnesia	18
Ferrous oxide	4

This mineral is grayish-white to pearl-gray, and greenish-white to greenish-gray. The best green transparent specimens are from the Mussa Alp and Zillerthal, but it is also found in the Urals and the United States.

Fluor Spar.

This mineral occurs in many colors, often approaching the finer gems in appearance, and bearing the commercial names of false ruby, false emerald, false topaz, etc., etc., according to its color.

Fluor spar is brittle, 4 in hardness, has the specific gravity of 3.1 to 3.2, single

refraction, is transparent to translucent, has a vitreous lustre, phosphoresces when heated, is attacked by acids, and melts before the blow-pipe. It is composed of:

Fluorine . .	48.7
Calcium . .	51.3

White, yellow, green, rose- and crimson-red, violet-blue, sky-blue, and brown, wine-yellow, greenish-blue, and gray are the colors of this many-tinted mineral.

Fluor spar is found in England, Norway, Baden, Nova Scotia, Thuringia, the Alps, Saxony, and the United States.

Large pieces of this mineral are made into beautiful vases and ornaments.

HYPERSTHENE.

Handsome specimens of hypersthene or Labrador hornblende are used for ornamental purposes.

This mineral is found in crystalline masses, has the hardness of 6, specific gravity 3.3 to 3.4, lustre pearly to metallic. It is translucent to opaque, brittle,

and fuses before the blow-pipe. It consists of:

Silica	54.2
Magnesia	24.1
Protoxide of iron . .	21.7

Hypersthene occurs in dark-brown, green, grayish-black, greenish-black, and jet-black colors, and is found in the isle of Skye, the Hartz Mountains, Saxony, Labrador, Greenland, Norway, Sweden, Bohemia, Thuringia, and the United States.

QUARTZ.

The quartz group is the largest and most diversified among precious stones. Quartz occurs *massive*, in concretions, and in confused crystalline masses.

On account of the abundance of the massive kinds, such as jasper, agates, onyx, etc., some writers place the quartz group under the head of semi-precious stones, and lately the United States customs authorities have gone further in that direction, and have ruled that "because

of the abundance and comparative cheapness of agates, onyxes, etc., they were no longer precious stones." This position, however, the custom-house speedily abandoned, and, for dutiable purposes at least, the quartz family, in all its ramifications, is recognized as belonging to the precious stones.

Harder than the tourmaline, turquois, or opal, as hard as the chrysolite, and nearly as hard as the garnet or emerald, there is no reason why the crystallized varieties, such as amethyst, cairngorm, false topaz, chrysoprase, and even the cat's-eye and finer onyxes, should not be classed among the precious stones.

Some more plentiful and less beautiful varities of quartz are not valuable, and they take the same position in the quartz family that the huge imperfect crystals do in the beryl group. Whenever the specimen is sufficiently beautiful to be cut and polished for setting in jewelry, it should be included under the precious stones.

Quartz crystallizes in the rhombohedral system, and many varieties are found massive and compact. The cleavage is indistinct but can sometimes be found by plunging a heated crystal into cold water. The hardness of quartz is 7; specific gravity 2.5 to 2.8, the purest kinds being 2.65; the lustre is vitreous to resinous, and fracture conchoidal.

Quartz is tough, brittle, and feels cold; it becomes positively electric by rubbing, shows phosphorescence in the dark, and gives sparks if struck with another piece of quartz or with steel.

Quartz is transparent to translucent, semi-translucent to opaque, doubly refractive, and does not melt before the ordinary blow-pipe, but may be melted with the oxyhydrogen blow-pipe. It also melts with soda to a clear glass, and is soluble in fluohydric acid.

Quartz is composed of pure silica

Oxygen . .	53
Silicon . .	47

Some of the impure varieties contain oxide of iron, carbonate of lime, clay, and other minerals.

CRYSTALLIZED QUARTZ.

Colorless quartz or pure rock-crystal is found in many parts of the world, notably in Switzerland, Dauphiny, Piedmont, the Carrara quarries in Italy, Canada; in Herkimer County, New York, and on the shores of Lake George, in the same place; at Hot Springs, Arkansas; and along the beach of Long Branch, Cape May, and many other places.

Rock-crystal, commercially known as Bohemian diamond, occidental diamond, Lake George diamond, rhinestone, pebble, etc., etc., is colorless and transparent. This stone is largely used for optical purposes, and is also sometimes cut into brilliants to imitate the diamond.

While rock-crystal is considerably harder than strass or paste, it lacks, however, the brilliancy of the fine-composition imitation diamond.

Besides being much softer, the paste is often heavier than the crystal, because of the quantity of lead and other minerals used in its composition.

Amethyst.

Amethystine quartz or amethyst varies in color from light to clear-dark purple, sometimes nearly black, and from light to dark bluish-violet. The coloring of the stone is supposed to be due to manganese.

The best amethysts come from Brazil and Ceylon, but good specimens are found in India, Persia, Botany Bay, Transylvania, near Cork and the island of May in Ireland, at Oberstein, in Saxony, in Hungary, Siberia, Nova Scotia, Sweden, Bohemia, Canada, and in the States of Maine, Pennsylvania, Colorado, Georgia, Virginia, and Michigan.

Under heat, the amethyst turns first yellow, then green, and finally becomes colorless. The value of an amethyst depends upon the fashion, and the time has

been when these stones ranked among the most valuable of precious stones. At present, a fine amethyst can be bought for very little money, but should the stone become fashionable again, the best specimens will command good prices.

Yellow Quartz.

Yellow quartz, known as false topaz, Bohemian, occidental, Indian, or Spanish topaz, resembles the real topaz in color, but is softer, lighter, different in crystallization and cleavage, and in electrical properties.

In color, this stone varies from the lightest yellow to orange-red and brown.

Most of the yellow quartz comes from Brazil, and much of it is changed to yellow by burning amethyst and smoky quartz.

Cairngorm, etc.

Smoky yellow to smoky brown, often gray and black, are the tints of the cairn-

gorm. This species of transparent quartz takes its name from Cairngorm in Invernessshire, in Scotland, a locality where some of the best specimens have been found. Pike's Peak, Arkansas, and certain districts in North Carolina have also produced some very fine smoky topazes.

The cairngorm is used for seals, beads, and some of the cheaper jewels, and is largely sold at watering-places in Switzerland, and in the Western United Sates.

The stone is very popular in Scotland. Hair or needle stones is the name given to these varieties of crystallized quartz when they contain foreign substances, such as rutile, manganese, chlorite, etc., in hair or needle formation.

These stones are cut to represent the needle enclosures in an upright position, and are called sagenite or Venus hair stones or love arrows.

Iridescent or rainbow quartz is the variety of rock-crystal containing cracks and fissures which reflect all the colors of

the rainbow. Quartz can also be artificially colored by rapidly cooling a heated specimen and then dipping the piece into a coloring preparation; the minute cracks in the quartz absorb the coloring matter, and the result is a red-, blue-, or green-tinted stone.

The massive varieties of quartz embrace the rose quartz, avanturine, cat's-eye, crocidolite, heliotrope, chrysoprase, prase, plasma, chalcedony, agates, onyx, carnelian, jasper, hornstone, and flint.

Rose Quartz.

Rose quartz occurs in a massive form, usually very imperfect and cracked, and varying in color from rose-red to pink. The color is supposed to be due to titanic acid, and often becomes paler on exposure.

This stone is nearly opaque and semi-transparent on the edges, has a greasy lustre, and specific gravity of 2.65 to 2.75. Rabenstein near Zwiesel in Bavaria, the

United States, Brazil, France, Ceylon, Finland, and Siberia are places where rose quartz has been found.

AVANTURINE.

Avanturine is an opaque, yellow, brown, or red quartz, spangled with minute scales of mica or some other mineral, and found principally near Madrid, in Spain. It is also found in France, Scotland, Bavaria, the Urals, and Styria.

A beautiful imitation of avanturine, called goldstone, is manufactured of glass into which metal filings are introduced. This goldstone is superior to avanturine in every point except that of hardness. Avanturine and its imitation, but largely the latter, are used for the cheaper kinds of jewelry, and were very popular in the United States some years ago.

CAT'S-EYE.

The Hungarian, occidental, or quartz cat's-eye is found on the coast of Malabar, Ceylon, Hartz Mountains, and Bavaria.

This stone is translucent to opaque, gray, green, brown, red, and the shadings of these colors, but usually a greenish-gray, with a mass of fine white lines in the centre, which give to the stone a chatoyant appearance.

The cat's-eye is usually cut cabochon or carbuncle-shaped, and the lines (which are due to the fibres of asbestos) are kept in the centre of the stone, and play like the eye of a cat when the stone is moved.

The quartz cat's-eye is easily distinguished from the oriental of chrysoberyl cat's-eye, as it is softer and much lighter.

Crocidolite.

Crocidolite or tiger-eye is a light-brown, brownish-yellow to dark-green, and greenish-blue quartz, which has the same chatoyant qualities as the cat's-eye. When cut cabochon, the crocidolite is called tiger-eye.

This beautiful mineral was very rare

some years ago, and good specimens were sold by the carat.

Great quantities, however, have lately been found in South Africa, and although the finest pieces are still used for cameos and intaglios, many objects, such as paper-weights, umbrella handles, match-safes, etc., are now cut from this stone.

Crocidolite is often artificially colored to very closely imitate some of the finest shades of the oriental cat's-eye.

Heliotrope.

Heliotrope or blood-stone, as this variety is commonly called, is a dark-green quartz, translucent to opaque, and covered with small red spots or blood-colored blotches, from which the stone derives the name of blood-stone.

This stone has long been used for seal and signet purposes, and many fine intaglios and cameos carved in blood-stone are in existence.

Bucharia, Tartary, Siberia, East India, China, the island of Rum in the Hebrides, the United States, and Canada are some of the places where the heliotrope is found.

Chrysoprase.

The chrysoprase is an apple-green chalcedony, sometimes olive- or whitish-green. It is translucent, scratches glass, and has the specific gravity of 2.56.

The color is due to the presence of oxide of nickel. This stone is found principally in Silesia, but also in Siberia and the United States.

Large pieces of chrysoprase are rare, and even the best specimens lose their color in course of time.

Prase.

A translucent, spotted leek-green, green quartz, which loses its polish on exposure to the air, is known as prase.

This stone is found principally in the iron mines of Brietenbaum, Saxony, and

also in Brittany, the Tyrol, Scotland, Salzburg, Finland, and the United States.

Prase is sometimes known commercially as "mother of emerald," and a greenish crystalline quartz is also often called prase.

Plasma.

Plasma is a dark grass-green quartz, feebly translucent, and is sometimes covered with white or yellow spots. Plasma is somewhat lighter in weight than the heliotrope and does not take as fine a polish.

This stone is found in India, China, and in the Black Forest, Germany.

Chalcedony.

Chalcedony is cloudy or translucent, white, yellowish-gray, blackish-brown, light to dark-blue, milky-white, and black.

This quartz is sometimes nearly transparent, waxy in lustre, and in some varieties has a light gray and transparent base with dark cloudy spots. This last variety

is called "cloudy chalcedony. Another kind, with gray and white stripes alternating, is known as chalcedonyx.

Iceland, the Faroe Islands, Hüttenberg, Loben, Saxony, Hungary, Nubia, Nova Scotia, Oberstein, Ceylon, India, Siberia, Carinthia, the Hebrides, the United States, and Canada are places where chalcedony is found.

Agates.

Agate is an improved variety of chalcedony and comprises the following kinds.

Banded or ribbon agate, running in delicate parallel layers.

Eye agate, forming concentric rings with a dark centre, giving the appearance of a human eye.

Fortification agate, running in circular parallel zigzag lines like the walls of a fortress.

Rainbow agate is a thin or concentric structure which when cut across and held towards the light shows an iridescence.

Moss agate, light-gray to white and translucent to opaque agates, display black tracings like fine moss or trees. Mocha or tree agates are covered with black, brown, or red figures, as of trees and plants.

Beckite or silicified coral shells, silicified wood, wood agate, wood opal, cloudy agate, and agate jasper are some of the many varieties of this class.

The common carnelians, blood-stones, and onyxes are usually counted among the agates.

Uruguay, Brazil, Oberstein, Silesia, Surinam, India, Arabia, Saxony, Scotland, the United States, and Canada are the principal places where agates are found.

Onyx or Agate Onyx.

Onyx is a variety of chalcedony in bands or strata of white, gray, and black, translucent to opaque, and generally found where agates abound.

The layers or bands are in even planes, and the colors, white and black, white and

brown, or brown, white, and black, alternate. This stone is largely used for cameos, the base being usually of black or brown, and the engraved or upper part white- or cream-colored.

When one or more layers are of carnelian or sard, the stone is called sard-onyx. Sard is a rich brown color inclining to red, and when held against the light shows a red hue.

Onyx and sard-onyx are often artificially improved by boiling the stones in honey, oil, or sugar water, and then in sulphuric acid. The acid carbonizes the sugar or oil which the stone has absorbed and gives it a deeper color.

For red, protosulphate of iron is added, and for a blue color to imitate lapis lazuli, yellow prussiate of potash is added to the protosulphate of iron.

Only the porous parts of the stones, usually the dark parts, absorb the sugar or oil, and so aid the contrast of the colored with the white layers.

Carnelian.

Carnelian is a clear red translucent chalcedony, and is usually of a gray or grayish-red color. Several weeks of exposure to the sun's rays and subsequent heating in earthen pots enhances and deepens the color.

The brownish-red or dark-brown carnelian is called sardoine or sard; the blood-red to pink varieties, with an upper layer of white onyx, are called carnelian onyx, and the stones with a brown or sard base and a white top are called sard-onyx.

Carnelians are sometimes of a yellowish-brown or yellow color, but red to brown are the principal colors.

The secret of coloring agates was discovered in the early part of this century, and about the same time agates became scarce in Oberstein, while large finds were made in Brazil and Uruguay, especially of agates with red layers. This variety comes chiefly from Brazil.

Besides Uruguay and Brazil, carnelian

is found in Arabia and India. The most beautiful specimens of intaglios are engraved on sardoine, and some of the finest cameos extant are of sard and carnelian onyx.

JASPER.

Jasper is an impure opaque quartz, usually containing more iron than agate, and lacking the quality of translucency. Jasper occurs in red, brown, ochre-yellow, dark green, brownish-green, grayish-black, and grayish-blue; sometimes containing bands or spots or quartz formations, and often found with regular zones or bands of various colors.

Egyptian jasper or Egyptian pebbles are names given to varieties that are usually brown with inner bands of lighter hue, approaching cream in color, and sometimes having dark bands with spots or markings.

Egyptian jasper is found near Grand Cairo, and other varieties are found in the

Urals, Saxony, Devonshire, Nova Scotia, Canada, and the United States.

The specific gravity of jasper varies from 2.31 to 2.67; it scratches glass, but yields to rock-crystal.

False Lapis.

False lapis is jasper or agate artificially colored blue to imitate the true lapis. Lapis lazuli is softer than false lapis, being only 5 to 5.5 in hardness.

Sappharine or siderite is a sapphire or sky-blue chalcedony occurring in Saltzburg.

Nicolo is a variety of onyx with a black or brown base and a band or layer of bluish-white on top. The upper layer is not flat, but convex, and is always thicker than the lower one.

Hematite.

Hematite was once largely used to engrave upon, many of the ancient intaglios being on this mineral. It is now cut to

simulate black pearls, and is also used in the cheaper jewelry, both engraved and cut cabochon.

Hematite has the hardness of 5.5 to 6.5, and specific gravity, 4.2 to 5.3; it is opaque, and shows a red streak when scratched. It is composed of:

Iron, . . .	70
Oxygen, . .	30

The colors of hematite are dark-steel gray to iron-black, and sometimes brownish- to blood-red. The lustre is highly metallic, with slight iridescence.

The island of Elba, France, Switzerland, Italy, Norway, Sweden, Bohemia, England, Brazil, Chili, Canada, Spain, and the United States are places where hematite is found. The Germans call this mineral "blood-stone," and it is also known as specular iron ore and iron glance.

OBSIDIAN.

Obsidian, or volcanic glass, does not occupy a high position as a gem or as an ornamental stone, but its antiquity and

occasional use among the agates and semi-precious stones will justify its mention.

This mineral is a melted lava, and consists of silex, alumina, and a little potassa, soda, and oxide of iron. Obsidian is 6 to 7 in hardness, has a specific gravity of 2.25 to 2.8, is sometimes transparent but mostly translucent to opaque, and is vitreous to metallic in lustre. It is brittle and not easily attacked by acids. It melts before the blow-pipe and takes a high polish.

Obsidian comes from volcanoes, and is found in Iceland, Teneriffe, Lepare islands, Peru, Mexico, Sicily, and on all volcanoes. The color is velvety-black to gray, brown, greenish-black, yellow, blue, bottle-green, and white, seldom red, and often with black or yellow spots or veinings.

Iceland agate lava, volcanic lava, and royal agate are all obsidian.

MALACHITE.

Malacnite although sometimes used for jewelry, is now more largely employed for

mosaic work and ornamental vases, and is sufficiently costly and rare to be classed amongst the precious stones.

Malachite is 3.5 to 4 in hardness; has a specific gravity of 3.6 to 4; is translucent to opaque; the lustre is vitreous to adamantine. It is attacked by acids, and melts before the blow-pipe. It is composed of:

Carbonic acid . . .	20.
Protoxide of copper .	71.8
Water	8.

Malachite occurs in emerald or verdigris green color, sometimes in alternating stripes of different shades of green, and occasionally in leek- to blackish-green.

Malachite is found in Russia, France, the Tyrol, England, Scotland, Ireland, Germany, Africa, Chili, Australia, and the United States.

The finest specimens are found in the Urals—a block three and a half feet square, being valued at 525,000 roubles.

JET.

The making of jet or mourning jewelry was once a very large industry in France and England, and even now Whitby jet is well known in commerce.

Jet is a species of bituminous coal (cannel coal) which can be cut with a knife. The hardness is 1 to 2.5; specific gravity, 1.35; its lustre is not very high, and color pitch-black.

It is found in England, France, Hesse, Spain, Italy, and Prussia.

AMBER.

Amber is a fossil, and is not to be classed amongst minerals, but this material has always been used as an ornament, and a few notes will not be out of place here.

This vegetable fossil, which has been known to the world for ages, the Greeks called electron.

It is very light, having a specific gravity of 1.065 to 1.08, and is 2 to 2.5 in hardness.

The principal color is yellow, in various shades, sometimes running into white or reddish-brown and black.

Amber is transparent to translucent, possesses single refraction, a resinous lustre to a high degree, becomes electric by rubbing, and burns readily before the blow-pipe.

Amber when heated becomes soft and pliable.

Amber is composed of:

Carbon	79.
Hydrogen	10.5
Oxygen	10.5

Amber is imitated by gum copal, and even the insect enclosures which occur in real amber are copied.

These imitations can be detected by placing the specimen in water or alcohol. This is also a good test for pieces of real amber that have been melted or glued together.

Amber is thrown up by the sea, in rivers near the sea, or on the sea-shore, and

has been found in nearly all parts of the world.

The Russian, Baltic, and Sicilian coasts have yielded the larger portion of the production, but supplies come also from Galizia, the Urals, Poland, China, and the United States.

For ornamental purposes the faceted amber beads are largely used, but of late years these have been closely imitated in glass.

CORAL.

Coral, although not a precious stone, has been largely used in jewelry, and as some of this beautiful substance is very valuable, a few words will not come amiss.

Red or precious coral is the work of a family of zoöphytes which live mostly in cavities of rock in the sea.

These polyps build their homes at a depth of two to seven hundred feet under the surface of the sea, and although the single groups of coral are sometimes

several feet long, the usual size is about twelve inches high, and about one inch at the thickest part of any single branch.

Coral is usually red, and rarely white or black, while the pale rose-pink is the most esteemed color.

Coral is mostly found at Calle, off the coast of Africa, but also on the coasts of Tunis, Algiers, Corsica, Barbary, Majorca, and Minorca.

Coral fishing-vessels leave Italy the beginning of March and return from the African coast in October; at one time as many as four hundred vessels were engaged in this industry.

TABLE OF HARDNESS AND SPECIFIC GRAVITY.

	HARDNESS.	SPECIFIC GRAVITY.
Achroite	7. — 7.5	3. — 3.1
Alexandrite . . .	8.5	3.65 — 3.8
Almandine	7.5	4. — 4.2
Almandite	7.5	4. — 4.2
Amber	2. — 2.5	1.065 — 1.08
Apatite	4.5 — 5.	2.95 — 3.25
Axinite	6.5 — 7.	3. — 3.3
Beryl	7.5 — 8.	2.67 — 2.73
Bobrowska garnet . .	6.	3.85
Bohemian " . .	7.5	3.69 — 3.78
Brazilian emerald . .	7. — 7.5	3. — 3.1
" sapphire .	7. — 7.5	3. — 3.1
Cachelong	5.5 — 6.	2. — 2.1
Cat's-eye	8.5	3. — 3.8
Ceylon chrysolite . .	7. — 7.5	3. — 3.1
" peridot . . .	7. — 7.5	3. — 3.1
Chrysoberyl . . .	8.5	3.65 — 3.8
Chrysolite	6.5 — 7.	3.3 — 3.5
Chrysoprase . . .	7.	2.56
Cinnamon stone . .	6.5	3.5 — 3.56
Cyanite	5. — 7.	3.45 — 3.7
Cymophane	8.5	3.65 — 3.8
Demantoide . . .	6.	3.85
Diamond	10.	3.5 — 3.6
Dichroite	7. — 7.5	2.56 — 2.67
Diopside	5. — 6.	2.9 — 3.5
Emerald	7.5 — 8.	2.67 — 2.73
Epidote	6. — 7.	3.32 — 3.50
Essonite	6.5	3.5 — 3.56
Euclase	7.5	3.1
Fluor spar	4.	3.1 — 3.2

	HARDNESS.	SPECIFIC GRAVITY.
Garnet	5. — 8.	3.15 — 4.3
Grossularite . . .	6.5	3.5 — 3.56
Hematite	5.6 — 6.5	4.2 — 5.3
Hiddenite	6.5 — 7.	3.13 — 3.19
Hyacinth	7.5	4.4 — 4.7
Hydrophane . . .	5.5 — 6.	2. — 2.1
Hypersthene . . .	6.	3.3 — 3.4
Idocrase	6.5	3.35 — 3.45
Indicolite	7. — 7.5	3. — 3.1
Jacinth	7.5	4.4 — 4.7
Jargoon	7.5	4.4 — 4.7
Jasper	7.	2.31 — 2.67
Jet	2.5	1.35
Labrador	6.	2.62 — 2.76
" hornblende .	6.	3.3 — 3.4
Lapis lazuli	5. — 5.5	2.38 — 2.42
Malachite	3.5 — 4.	3.6 — 4.
Moonstone	6. — 6.5	2.4 — 2.6
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Oriental amethyst . .	9.	3.9 — 4.1
" aquamarine .	9.	3.9 — 4.1
" chrysolite .	9.	3.9 — 4.1
" emerald . .	9.	3.9 — 4.1
" hyacinth . .	9.	3.9 — 4.1
" topaz . . .	9.	3.9 — 4.1
Pearl		2.5 — 2.7
Peridot	6.5 — 7.	3.3 — 3.5
Phenacite	7.5 — 8.	2.96 — 3.
Pyrope	7.5	3.69 — 3.78
Quartz	7.	2.5 — 2.8
" cat's-eye . .	6. — 6.5	2.65
Rose quartz	7.	2.65 — 2.75
Rubellite	7. — 7.5	3. — 3.1
Ruby	9.	3.9 — 4.1
" cat's-eye . . .	9.	3.9 — 4.1
Sapphire	9.	3.9 — 4.1
" cat's-eye . .	9.	3.9 — 4.1

	HARDNESS.	SPECIFIC GRAVITY.
Siberite	7. — 7.5	3. — 3.1
Sphene	5. — 5.5	3.4 — 3.56
Spinel	8.	3.5 — 3.6
Spodumene	6.5 — 7.	3.13 — 3.19
Star ruby	9.	3.9 — 4.1
" sapphire . . .	9.	3.9 — 4.1
" topaz	9.	3.9 — 4.1
Sunstone	6. — 7.	2.56 — 2.72
Syrian garnet . . .	7.5	4. — 4.42
Titanite	5. — 5.5	3.4 — 3.56
Topaz	8.	3.4 — 3.6
Tourmaline	7. — 7.5	3. — 3.1
Turquois	6.	2.6 — 2.8
Uwarowite	7.5	3.41 — 3.52
Vesuvianite . . .	6.5	3.35 — 3.45
Water sapphire . .	7. — 7.5	2.56 — 2.67

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